THE RELATIONSHIP BETWEEN DURATION OF BEDREST AND OCCURRENCE OF DEEP VEIN THROMBOSIS IN PATIENTS HAVING UNDERGONE TOTAL HIP REPLACEMENT SURGERY

by

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ABSTRACT

This ex post facto study examined the medical records of 100 patients who underwent total hip replacement surgery (THR) in order to ascertain the relationship between duration of bedrest and incidence of deep vein thrombosis (DVT) in a Salt Lake City hospital. No cases of DVT were documented in the charts reviewed.

Results indicated that ambulation following three days of bedrest after THR surgery appears to be sufficient to avoid complications of venous emboli. However, limitations such as the retrospective design and use of clinical signs to detect DVT, limited the validity of the results. Five patients presented simultaneous risk factors for DVT and complications that suggested the need for a more objective test to definitively rule out the disorder.

The use of a more sophisticated technique to confirm the efficacy of early ambulation and anticoagulant therapy in the prevention of DVT in THR surgery patients is recommended. Nurses are urged to develop awareness of the risk factors and to maintain suspicion in the face of clinical signs for DVT.

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CHAPTER I

INTRODUCTION AND CONCEPTUAL FRAMEWORK

Introduction

Prolonged confinement to bed conflicts directly with physiological conditioning. All patients who are in bed for long periods of time are threatened by the harmful effects of recumbency. One of these harmful effects is deep-vein thrombosis (DVT) which can lead to fatal complications such as pulmonary embolism. The relationship between immobility in the form of bedrest and the incidence of deep - vein thrombosis (DVT) has been investigated in postmortem surgical patients, as well as in normal subjects; however, little is known about the actual extent to which bedrest can be considered a risk factor in the incidence of deep-vein thrombosis (DVT).

The difficulty begins with the conceptualization of the term "bedrest" which has been poorly defined. The amount of activity permitted the patient is neither adequately described nor controlled. Additionally, other complex factors involving the diseased patient such as severity of illness, age, physical fitness

and diet impede the consideration of bedrest as a separate entity in the development of DVT.

Although the etiology of DVT remains unknown, clinical and postmortem studies and more recently, the use of sophisticated diagnostic aids with living patients, have identified factors that increase the risk of its occurrence. Among these are orthopedic surgery, particularly total hip replacement. Whether these risks are similar for other patients or within differing hospitals remains unknown. There is, therefore, a need for further research to identify patients at risk for developing DVT in a specific environment. Prophylaxis could then be initiated on a selective basis if patients at high risk were identified earlier.

Problem Statement

Is the occurrence of DVT related to duration of bedrest in patients who have undergone total hip replacement surgery?

Purposes of the Study

This research project had two purposes. The first was to investigate the relationship between duration of bedrest and occurrence of DVT in patients who had undergone total hip replacement surgery. The second purpose was to identify and correlate possible contributory factors in the development of the disorder.

These factors included: a) increased age, b) obesity, c) presence of heart disease, d) varicose veins, e) malignancy, f) blood type, g) type of anesthesia, h) past history of thromboembolism and i) smoking.

Conceptual Framework

It is known that confining a patient to bed creates problems. These include gastrointestinal difficulties, such as constipation and distension, backaches, muscle cramps and pulmonary disorders, as well as effects on the morale of the patient. DVT causes great concern as a result of decreased activity in bedridden patients because it has been highly correlated with the most serious consequence of bedrest, pulmonary embolism (Sevitt & Gallagher, 1961; Kakkar, Howe, Flanc, & Clark, 1969). The relationship between bedrest and DVT can be supported by the following factors. During immobilization there is a reduction in venous flow in the lower limbs that falls progressively with the duration of bedrest. As a consequence, the extravascular fluid increases and progressive venous engorgement develops. These changes are believed to be due either to impaired veins or leg muscle tone or a combination of both factors. The decrease in plasma volume results in elevated blood viscosity which, associated with the loss of pumping action of the calf muscles, will

theoretically predispose the patient to thrombus development.

Pointed out in the literature are several risk factors for the development of DVT. The clinically silent nature of DVT has been recognized, diagnostic aids have been developed and preventive measures have been initiated. However, an accurate diagnostic technique is invasive and painful, and the preventive measures are not free of risks requiring vigilance and extra work. The failure of preventing deep vein thrombosis creates the risk of occurrence of pulmonary embolism which is often life threatening (Lee, Madden, Trainor, Kavner, Dratz & Ejercito, 1976).

Nurses are directly responsible for the care of patients in the hospital. Hence, they should discern those patients at high risk of developing the disorder and apply specific preventive measures to decrease the patient's risk of developing DVT.

CHAPTER II

REVIEW OF THE LITERATURE

When a thrombus develops in the deep veins of the lower extremities it is classified in two forms: phlebothrombosis and thrombophlebitis (Oschner & DeBakey, 1939). Phlebothrombosis is defined by Homans (1939) as a thrombus that is either nonadherent or very loosely attached to the intima and is not associated with inflammatory reaction. There is evidence that thromboembolism is more likely to occur with this kind of thrombus (Oschner & DeBakey, 1939). Thrombophlebitis indicates inflammatory reaction associated with thrombosis. The chances of occurrence of thromboembolism are remote. Throughout this paper the term deep vein thrombosis (DVT) will be used to indicate any kind of manifestation of a thrombus in the leg in any location.

In 1845, Virchow presented his hypothesis about the nature of thrombotic diseases. He hypothesized that a) variations in the blood, b) modifications in vessel walls, and c) differences in the rate of blood flow might singularly or in combination predispose to

thrombosis. Throughout the next 150 years, researchers carefully analyzed each entity of the Virchow triad in order to identify a specific cause for thrombotic disease. Their results showed that each member of the triad could not be considered separately and efforts to treat each as an independent variable were not successful.

Among the researchers interested in studying the Virchow triad as separate entities are Wessler and collaborators (1962) who assumed that hypercoagulability conditions would be present in localized parts of the circulation even when the rest of the blood was normal. Studies of change in venous blood flow did not necessarily show alterations occurring in small, localized segments of the vascular tree.

Stasis is considered one of the most important factors in the formation of a thrombus in a vein. Physiologically, the return of the circulation to the right side of the heart is dependent upon five factors: a) the force of the heartbeat, b) the contraction of the muscles of the extremities, c) aspiration action of the thorax, d) viscosity of the blood, and e) the effect of gravity. In fact, disarrangements in one or more of these factors, which may provoke stasis in the venous circulation and predispose the development of a thrombus, are commonly diagnosed in heart disease: a) malnu -

trition, b) hemorrhage, c) shock, d) trauma, e) dehydration, f) the improper positioning of the patient in bed and g) the pressure of constricting dressings (Browse, 1965).

The great concern in diagnosing DVT in the early stages is the avoidance of the fatal complication of pulmonary embolism and prolonged postphlebitic disability. It has been documented that DVT and pulmonary embolism are common complications of different medical disorders, surgical procedures and trauma. They are responsible for great morbidity and mortality. Precise statistics are difficult to obtain but it is estimated that some 50,000 patients per year die from pulmonary embolism (Hume, Sevitt & Thomas, 1970; Wessler, 1975). Evidence demonstrates that the great majority of emboli arise as thrombi in the deep veins of the lower extremities or pelvis, become detached and then are carried to the lungs. Deep leg vein thrombosis frequently arises in the venous sinuses of the calf muscles and extends into the major deep calf veins, the posterior tibial and the peroneal veins (Nicolaides, Kakkar, Field & Renney, 1971). A significant proportion of calf vein thrombi expand further into the popliteal, femoral or iliac veins (the proximal veins) (Kakkar et al., 1969). There is evidence of the occurrence of proximal vein thrombi independently of calf vein

thrombosis, particularly when there is surgical trauma in the vicinity as in hip surgery (Freiman, 1975). It has been observed that important embolism occurs more often in patients with proximal vein thrombosis than when thrombosis is restricted to the calf (Kakkar et al., 1969). Postmortem studies have revealed that almost all patients with pulmonary embolism also have deep vein thrombosis (McLahin & Paterson, 1951). However, Browse (1975) mentioned that 50% of patients who have pulmonary emboli had no clinical evidence of deep vein thrombosis and 65% of individuals with autopsy for any reason manifest evidence of silent thrombi somewhere in the limb veins. Venography research of the living has shown that 50 to 72% of patients with pulmonary emboli have deep leg vein thrombosis (Browse & Lea-Thomas, 1974). Therefore, it can be concluded that pulmonary emboli rarely occur without leg vein thrombosis and that leg vein thrombosis frequently leads to embolism.

Venous thrombosis presents two clinical problems. First, the thrombus may fragment or be dislodged from its site of origin and become a pulmonary embolus. Second, the thrombus will injure the valves in the peripheral veins resulting in postphlebitic syndrome. Prevention of venous thrombosis and its consequences should be the major goal of the health team. However, there are certain obstacles to be considered since the

etiology of deep vein thrombosis is still unclear. For example, both prevention and treatment resources such as anticoagulant therapy are not free from hazards. In addition, the available screening techniques are either inaccurate, expensive or painful. Considering these factors, prevention or early detection of DVT should be restricted to those patients who are at risk for developing this disorder.

Diagnosis of DVT

The health team dealing with DVT faces two problems. First is the patient who comes to the emergency unit with a swollen leg; if DVT is suspected, it will be established as having occurred days or weeks earlier. Second is the patient who has been immobile in the hospital due to medical illness or surgery and a need for a diagnosis of DVT arises before it becomes clinically evident. In both situations, it is imperative to make an accurate diagnosis of DVT because the available treatment such as anticoagulant therapy is not free of risks.

A technique that is 99% accurate, noninvasive and easily managed has not been identified. The current available methods of diagnosis lack accuracy and present major risks and disadvantages.

Venography

Prentice (1978) considered venography to be the best method of diagnosing established DVT. The technique is invasive, requiring an injection into a foot vein which is painful to the patient. Therefore, it is not a useful technique for monitoring the progress or resolution of a thrombus. This method entails intravenous injections of radioopaque contrast medium into a foot vein with a tourniquet located around the ankle in order to force the contrast medium into the deep veins. The calf femoral and iliac veins are studied. The dye must be flushed out thoroughly with a saline solution as the contrast medium can cause inflammation and result in postvenogram thrombosis. Although accurate, venography cannot be used as a routine technique to detect venous thrombosis due the expense of the apparatus, the time-consuming nature of the procedure and the fact that a radiologist must be constantly present.

Venography is considered the definitive test for diagnosing suspected venous thrombosis. Although a better technique has not yet been developed, it is impossible to determine the number of missed DVT cases when using the venography technique for diagnosis.

125I Fibrinogen

The clinical application of this technique was

initiated in 1968. It has been used as an investigative method (Flank, Kakkar & Clarke, 1968; Negus, Pinto, LeQuesne, Brown & Chapman, 1968). An important aspect of this technique is that higher rates of accumulation of radioactivity are found over the thrombus if 125I labelled fibrinogen is given before the thrombus forms. Therefore, it is a useful technique for surgical patients requiring immobilization since the isotope can be given before the surgery or at the onset of immobility (Prentice, 1978). Thrombosis is detected by accumulation of radioactivity at the site of the thrombus due to transformation of radioactive fibrinogen to fibrin at this point. The use of this technique has yielded important information about the natural history of DVT. For example, it is now known that many small thrombi occur at the time of surgery and develop throughout the next two or three days (Prentice, 1978). The incidence of thrombosis, as detected by this method ranges from 25 to 30 percent after general major surgery to 65 to 70 percent after orthopedic surgery, such as repair of a hip fracture (Kakkar, 1972; Negus et al., 1968; Stevens, Fardin & Freear, 1968).

The problem reported with this technique is related to the sensitivity. Many thrombi detected through this method are clinically unimportant and spontaneously resolve without treatment (Kakkar, 1972).

Impedance Plethysmography

This technique is based on the observation that blood conducts electricity and that when blood accumulates in a vein following inflation of a cuff on the leg, electrical resistance decreases (Prentice, 1978). Impedance values show significant reduction in patients with popliteal and proximal veins blocked. The technique is simple but it appears to be limited to diagnoses of clinically suspected popliteal, femoral or iliac vein thromboses. Additionally, it is probable that the thrombus must be occlusive rather than nonocclusive in order to be detected using impedance plethysmography (Prentice, 1978).

Doppler Ultrasound Flowmeter

This technique utilizes a beam of ultrasound placed on the vein to be examined. If blood is circulating in the veins, the beam reflects this movement in different frequencies proportional to the speed of flow, producing an audible sound. With the presence of deep vein thrombosis, no sound is heard since no blood is moving in the portion of the vein. The primary advantage of this method is its practicality. Assessment of the legs can be performed in one or two minutes. However, the technique fails to detect small calf vein thrombi as soon as they appear.

Clinical Examination

The signs and symptoms of DVT were classified by Browse (1978) into two groups: a) those produced by venous obstruction and b) those produced by inflammatory changes that circumscribe the thrombus. Venous obstruction results in swelling of the leg, dilatation of the superficial vein, increase in skin temperature, and, in acute cases, a bluish discoloration of the skin of the leg. The inflammatory changes in the vein wall generate both pain and tenderness. Swelling, discoloration, pain and tenderness are simple signs and symptoms to recognize in a routine examination. However, according to Coon and Cooler (1959) they are unreliable. These investigators reviewed a series of 595 cases of pulmonary emboli confirmed by autopsy. They reported that only 71% had clinical diagnoses of pulmonary emboli and only 10.6% of the patients had a premortem clinical diagnosis of peripheral venous thrombosis. McLachlin, Richards and Peterson (1962) were more optimistic about the reliability of the clinical signs of DVT. They reported that unilateral swelling of the left ankle gave an 80% chance of making an accurate diagnosis of the disorder. Kakkar argued that "if one relies solely on clinical signs, there will be failure to diagnose the condition in 50% of patients" (Kakkar et al., 1970, p. 527). Although not 99% accurate, clinical examination is easy

and can be used by clinicians and nurses in routine patient assessment as an alert to the potential danger of DVT. However, it must be kept in mind that the absence of clinical signs does not rule out the presence of DVT.

The ^{125}I fibrinogen screening technique has been the most useful in studying the effects of prophylaxis for DVT. Venography, while the best test for evaluation of clinically suspected thrombosis, is a painful, invasive and lengthy procedure.

Risk Factors in DVT

Although the cause of DVT remains obscure, 150 years of venous thromboembolism research has contributed to the identification of predisposing risk factors for hospital patients. These are: a) inactivity, b) surgery, c) increasing age, d) malignancy, e) heart disease, f) pregnancy and oral contraceptives, g) obesity, h) ethnic factors, i) past history of venous thromboembolism, j) blood groups, and k) other factors.

Inactivity

A correlation between inactivity in the form of bedrest and venous thrombosis was mentioned many years ago and was supported by autopsy dissections (Gibbs, 1957; Roberts, 1963; Sevitt & Gallagher, 1961). Gibbs reported a rapid rise in the frequency of occurrence of DVT which began within three days of the initiation of bedrest;

the frequency was 15 percent in patients who had been confined to bed for up to seven days and 90 percent in those confined three to four weeks prior to death. Injured and burned patients were studied by Sevitt and Gallagher (1961). They identified DVT in 19 percent of those who died within three days, 47 percent in those who died in the course of the next four days, and 75-90 percent of those who died later.

Flanc et al. (1968) studied the incidence of venous thrombosis in living patients. However, their results conflicted with autopsy findings. Flanc's research protocol involved diagnosing the venous thrombosis by leg scanning after the preoperative injection of 125I labelled fibrinogen and confirmation by venography. The researchers found that radioactive counts in the leg increased in half of the patients following surgery. The increased counts were classified in three patterns: early transient, early sustained, and later rises. In those patients with early transient rises, the venograms were normal and the elevated counts were often "localized to the mid-calf, the area of the soleal sinuses" (Flanc et al., 1968, p. 746). It was assumed that the transient rises were due to the pooling of blood in the soleal sinuses or to minor thrombi which had been destroyed by natural processes by the time venography was performed. The early sustained and later rises re-

presented formed thrombi because their presence was confirmed by venogram in almost every case. Thirty-five and 50 percent of postoperative thrombi were discovered when the patient returned from the operating room, suggesting that thrombi developed during the operation. The disparity between the incidence of DVT in the autopsy and venography studies is difficult to explain. The authors suggested that perhaps the autopsy procedures were not sensitive enough to detect fresh thrombi.

Preoperative inactivity may also lead to preoperative DVT. A study of high risk patients admitted to the hospital for preoperative investigation, colon preparation, or intravenous feeding for approximately 4 to 30 days prior to surgery was done by Heatley, Hughes, Morgan and Okuonga (1976). Twenty percent of the patients developed thrombosis, with the majority of occurrences in the second week of the preoperative hospital stay.

When age and duration of bedrest were correlated, autopsy analyses confirmed that the chances of the occurrence of DVT were particularly great in middle-aged and elderly patients confined to bed for more than three or four days (Sevitt & Gallagher, 1961). Age was not important when the bedrest lasted more than a week. Even seriously burned children developed thrombosis due to prolonged immobilization (Sevitt & Gallagher,

1971). However, caution is necessary in the assessment of inactivity in the form of bedrest as a predisposing cause for the occurrence of DVT. Most of the investigations involved bedridden patients but it appears that the underlying disease causing the bedrest may be the more important risk factor.

In an attempt to explain the contribution of bedrest to the development of DVT, several authors have referred to the third member of Virchow's triad, venous stasis. This term is frequently used to connote either a decrease in the linear velocity of venous flow, or a decreased rate of venous return (Hume et al., 1970). Arterial perfusion of the limbs is dependent upon the volume returned per minute. When volume is reduced the following changes can be expected: venous dilation with no change in arterial flow with venous capacity unchanged and/or a mixture of venous dilation with a drop in arterial perfusion. According to Hume et al. (1970), venous dilation is a determining factor in the dropping of linear veolocity without necessarily decreasing venous return; although an excessive fall in linear velocity would result in venous pooling, which in turn affects cardiac output and arterial perfusion of the limb.

There is strong agreement that venous stasis, especially reduced linear speed of flow, plays a large role in the genesis of thrombi. There is evidence that the

linear speed of flow is greatly reduced when the limbs are supine (McLachlin & Paterson, 1951; Wright, Osborn & Edmunds, 1951). This was verified by Wright et al. who injected radioactive sodium in a foot vein in an attempt to determine the venous blood flow in the limb during bedrest of postoperative patients. It was found that blood flow gradually decreased to its lowest level after 7 to 14 days and this effect persisted for two to three weeks. Wright et al. also found that the venous flow did not decrease in patients who were instructed to ambulate after surgery.

Doran and his colleagues (Doran, Drury & Syvyer, 1964) suggested that the postoperative fall in venous blood flow could be prevented by electrical stimulation of the calf muscles during surgery. However, Brouse (1965) demonstrated that although physical activity increased arterial perfusion the effect on resting venous blood flow was transient and it remained low. He further emphasized that although the muscle pump is very important in the upright position, it plays a much reduced role in recumbency.

The effects of bedrest on circulation were studied in four normal healthy young men by Dietrick, Whedon and Shorr (1944). Bedrest was standardized by the use of bivalved plaster casts extending from the umbilicus to the toes. Surprisingly, they concluded that blood pres-

sure, circulation time and velocity of venous blood flow did not change significantly during the prolonged period of bedrest. Perhaps the healthy state of the subjects precluded any meaningful change in the circulation.

Studies of venous dilation during bedrest were provided by Lundbrook and Loughlin (1964) who found that the blood volume of the lower limbs increased. The reason for this phenomenon was attributed to the passive nature of the deep vein structure. "Their emptying depends on calf muscle contractions as well as the vis a tergo of arterial inflow." (Hume et al., 1970, p. 95).

There is very little evidence to support the notion that prolonged bedrest alone could be responsible for DVT development. However, some degree of immobilization frequently accompanies the diagnosis of DVT in hospitalized patients. Accurate prediction of amount of time that patients should remain on bedrest to avoid the numerous ill effects is still unknown. Available experimental pathological and clinical data support the hypothesis that venous thrombosis results from simultaneous combinations of stasis and the activation of clotting factors. Prophylaxis then is most likely to be successful if the hypercoagulable state is prevented through anticoagulant therapy and if stasis is overcome by in-

tensive physiotherapy and early ambulation.

Surgery or Other Trauma

Surgery or other trauma has been reported to be a precipitating event in DVT for many patients (Gallus, 1976). It also appears that the nature of the operation, its duration and type of anesthesia administered, is related to the risk of developing this condition. Among the various surgical procedures, orthopedic surgery to the lower limbs, such as total hip replacement, presents considerably higher risk for developing DVT (Kakkar, 1972; Stevens et al., 1968; Evarts & Feil, 1971).

The reported incidence of DVT in patients who have undergone total hip replacement surgery varies from 37 percent (Hume, Turner, Kuriahose & Suprenant, 1976) to 69 percent (Sagar, Nairn, Stamatakis, Maffei, Higgens, Thomas & Kakkar, 1976). Autopsy studies revealed that 77% of all deaths in the postoperative period are due to pulmonary emboli (Johnson, Carmichael, Almond & Loynes, 1978). Also, DVT is more common in the operated limb than in the nonoperated site (Hume et al., 1976; Harris, Salzman & DeSanctis, 1967).

The predisposing factors to increased risk of DVT in hip reconstruction are probably the simultaneous presence of the well-known Virchow's triad (vessel wall damage, venostasis and changes in blood constituents).

During total hip reconstruction damage to the vessel wall is likely to occur after forceful manipulation, prolonged retraction and long periods of recumbency while supine. Venostasis develops during dislocation of the hip, and is probably increased by retraction to expose the acetabulum (Houghton, Papadakis & Rizza, 1978).

Occlusion of the femoral vein has been demonstrated when the hip is dislocated during total hip reconstruction (Stamatakis, Kakkar, Sagar, Lawrence, Nairn & Bentley, 1977). According to Houghton et al. (1978) limb venostasis results in a rise in clotting factors II, V and VIII in the occluded limb, and does not affect the rest of the circulation. Although a hypercoagulable state is thought to be one of the factors necessary to induce thrombus formation, the stimulative mechanism by which this could cause thrombosis is not known. Besides the presence of the "triad," total hip replacement patients share other common features that enhance the probability of developing DVT. For example, age greater than 60 years, obesity, preoperative immobility and previous hip surgery are potential causative agents. This situation can be compounded when there are the somatory effects of other known risk factors for DVT such as previous history of thromboembolism, varicose veins, malignancy and heart disease.

Anesthesia

Anesthesia was suggested by Lewes, Muller and Edwards (1972) to produce blood stasis in the sinuses of the calf, hence contributing to thrombus formation. However, the role of anesthesia in the pathogenesis of DVT is a controversial issue. In a randomized study combining muscle relaxants with controlled ventilation compared with controlled ventilation without muscle relaxants, the use of muscle relaxants was found to be unrelated to the increased risk of DVT (Gallus, 1976).

Cundy and Negus (1981), however, pointed out:

> Even if we ignore any possible thrombogenic effects of relaxant drugs, the use of controlled ventilation instead of spontaneous ventilation during anesthesia may be of critical importance in the pathogenesis of DVT (p. 1528).

They noted that during controlled positive pressure ventilation, intrathoracic pressure is raised, consequently venous return is impeded. This alteration in the normal intrathoracic pressure, with a consequently higher femoral vein pressure and increased resistance to venous return from the leg, might be the significant factor in the development of DVT rather than the anesthesia itself (Cundy & Negus, 1981).

The influences of different anesthetic techniques such as epidural and general anesthesia on DVT and pulmonary embolism after total hip replacement surgery were recently researched by several physicians. Thirty

patients undergoing total hip replacement surgery were randomly assigned to two groups receiving either epidural (using spontaneous ventilation) or general (using controlled ventilation) anesthesia. Prophylactic drugs such as anticoagulant therapy or Dextran were not employed. Both groups followed the same physiotherapy program with early ambulation. The policy was to allow standing with full weight bearing on the day after the operation. The patients had no history of heart or lung disease, diabetes, previous thromboembolism or varicose veins. The frequency of DVT was diagnosed by venogram and was significantly lower in patients receiving continuous epidural blocks (3 of 15; 20%) than in those receiving general anesthesia (11 of 15, 73%). The frequency of pulmonary emobolism as diagnosed by perfusion lung scanning was lower in patients receiving epidural blocks (2 of 15) than in general anesthesia (7 of 15) (Modig, Hzelmstedt, Sahlstedt, & Maripuv, 1981). Epidural block prolonged into the postoperative period seems to offer advantages relative to thromboembolic phenomena in patients undergoing total hip replacement surgery due to the maintenance of spontaneous ventilation rather than controlled ventilation. If replication of this study proves to be feasible, this type of anesthetic technique coupled with other prophylactic measures might provide another alternative for patients undergoing

operative procedures with high risk for venous thromboembolism.

A number of prophylactic methods for prevention of DVT in patients undergoing total hip replacement surgery have been investigated. There is, however, little agreement regarding methodologies to be employed. Oral Warfarin (Coumadin) decreases the thrombotic event (Coventerey, Nolan & Bechenbaugh, 1973) but it is not widely used due to the high incidence of postoperative bleeding, wound sepsis (Crawford, Hillman & Charnley, 1968) and the need for monitoring laboratory work.

Presently there is a tendency to start anticoagulation prophylaxis two or three days after surgery in doses that prolong the prothrombin time between one and a half times and twice the control value on the fifth or sixth postoperative day (Coventerey et al., 1973). This method does not prevent the formation of small venous thrombi during or postsurgery (Pinto, 1970). However, it may be successful in impeding thrombus development and consequently reduce the frequency of venous thrombosis clinically.

Low dose Heparin and Dextran are relatively inefficient and have the same risk of bleeding (Evarts & Alfidi, 1973). Research using aspirin and other agents (Medical Research Council, 1972; Chrisman, Snook, Wilson & Short, 1976) have not demonstrated conclusive results

and cannot be considered effective prophylactic drugs.

Mechanical devices were designed to protect patients against DVT. The external pneumatic compression (EPC) method has been highly effective for other patients at risk for developing DVT, but it does not appear to be effective in patients undergoing hip surgery (Hirsch, 1981). The use of graduated compression stockings for prevention of DVT is very attractive due to its simplicity and potential for combination with other prophylactic agents (Barnes, Brand, Clarke, Harthy & Hoak, 1978) but this approach needs research confirmation in controlled trials in other centers. Early ambulation as a mechanical method of prevention following total hip replacement was researched by Convery, Barnes, Krugmire and Strandness (1974). The investigators proposed to develop two points, "the concept that peripheral venous clots that remain confined to calf are benign and unassociated with embolic complication" and "that prolonged bedrest associated with operative procedures is a common variable in the high rates of thrombosis" (Convery et al., 1974, p. 175). Their literature review cited the work of Gibbs (1957) (incidence of thromboembolism proportional to the duration of bedrest) and in the opinion of Convery et al. the aforementioned relationship was clearly demonstrated. The sample was comprised of 100 patients, with 108 hip replacement surgeries performed.

Routine prophylactic anticoagulation therapy was not employed. The patients received physiotherapy in bed and early ambulation was established as partial weight bearing by the fourth or fifth postoperative day. Clinical and Doppler ultrasonic evaluation revealed four patients had developed DVT postoperatively and one patient had a nonfatal pulmonary embolism. This low incidence of thromboembolic complication was thought to be due to physiotherapy in bed plus rapid postoperative ambulation. It is noteworthy that there was an absence of signs and symptoms in all four patients.

Charnley (1972) took a skeptical stance toward the stagnation of blood as a causative agent in DVT. He reported a massive pulmonary embolism in a patient walking on the first postoperative day following hip surgery. Further, he noted that there was no significant decrease of sudden unilateral edema of the leg in the second and third weeks compared with ambulation after the fourth postoperative day which was the previous routine. The manifestations of leg edema in the third postoperative week contradicts the belief that DVT leading to pulmonary embolism begins on the operating table. The author was also alarmed with some forms of anticoagulant therapy such as low dose Heparin. A fatal pulmonary embolism identified postmortem occurred in one out of 48 patients.

This investigator believes that it is important to examine and evaluate the magnitude of risk factors for DVT prior to applying innovative prophylactic trials.

Increasing Age

Postmortem studies have revealed that the frequency of venous thrombosis and pulmonary embolism increases with age (Coller, 1959; Sevitt & Gallagher, 1961). Increasing age is considered a factor in the incidence of venous thrombosis because it is associated with dilatation of the lower limbs (Gibbs, 1957) and this anatomical change promotes stasis of the venous blood flow. However, other risk factors associated with increasing age could account for this stasis. For example, the presence of heart disease, malignancy and the length of time that the elderly patients take to recover from an illness are potential causative agents.

Malignancy

The association of DVT with cancer was reported by Trusseau in 1865 (Morris & Mitchell, 1977). The presence of cancer, combined with surgery, increases the risk of venous thrombosis two- to threefold (Gallus, 1976). Carcinoma of the pancreas, stomach or lungs (in particular) have been demonstrated to increase this risk (Morris & Mitchell, 1977).

The mechanism through which cancer predisposes

the patient to thrombosis is unknown. However, it has been suggested by Pineo, Brain, Gallus, Hirsh, Hatton and Regoecci (1974) and Gordon, Frank and Lewis (1975) that it could be attributed to the release of procoagulant material, derived from the tumor, into the circulation resulting in the conversion of prothrombin into thrombin (Pineo et al., 1974; Gordon et al., 1975). This might explain the high risk associated with pancreatic tumors. In other cases, increased risk of venous thrombosis might be due to the older age of the cancer patients and to their confinement to bed because of complicated postoperative courses. This is substantiated by the fact that in the absence of surgery, venous thrombosis in cancer patients has also been attributed to inactivity and sepsis in terminally ill patients (Gallus, 1976).

Heart Disease

Myocardial infarction, particularly when complicated by heart failure, is associated with a two- to threefold increase in the risk of DVT of the leg (Gallus, Hirsh & Tutle, 1973). The early onset of the thrombus is noteworthy. Murray, Lorimer, Cox and Lawrie (1970) found that more than 50 percent of the thrombi studied developed within 72 hours of the acute infarction. They suggested that the formation of these thrombi were not

related to prolonged immobilization. On the other hand, it is possible that the immobilization predisposes proximal extensions of the thrombus to the thigh and femoral veins (Murray et al., 1970). Myocardial infarction patients who have history of DVT (Kakkar et al., 1969) or who have varicose veins, who are over 70 years old (Maurer, Wray & Shillingford, 1971; Simmons, Sheppard & Cox, 1973), or whose myocardial infarction was complicated by right heart failure (Marks, Teather, Farrag & Ashraf, 1979) are known to be more likely to develop DVT. Marks et al. (1979), in researching thrombotic consequences after myocardial infarction, proposed stasis and turbulence as major factors responsible for the pathogenesis of DVT. They explained that, in a normal heart, laminar blood flow moves rapidly, hence limiting the accumulation of elements in the vessels. Turbulence and stasis disrupt the laminar flow causing the elements to fall on the endothelium where they may adhere (Deykin, 1967). Additionally, the liberation of adenosive diphosphate (ADP) results in the aggregation of platelets which would be contributory inthe events leading to DVT. Further, the low output manifested in right heart failure would increase the pressure of the blood flow in the systemic veins, diminishing its speed and resulting in an altered distribution of blood formed elements (Marks et al., 1979). Moreover, low stroke volume, which is

usually present in myocardial infarctions, would induce a decrease in limb flow, thereby enhancing the chances of developing DVT.

The recommended period of bedrest following a myocardial infarction has varied widely (Groden, Allison & Shaw, 1967; Hayes, Morris & Hampton, 1974) and it remains unclear whether the risk of venous thrombosis is related to the severity of the underlying disease, or to the prolonged bedrest to which the critically ill patient may be subjected.

Pregnancy and Oral Contraceptives

Pulmonary embolism continues to be a common cause of maternal mortality. In fact, in England and Wales, it is the most common cause of maternal mortality and results in approximately 30 deaths in every one million deliveries (DHSS, 1975; Morris & Mitchell, 1977).

According to Henry (1975) patients who died of pulmonary embolism during pregnancy or postpartum usually present with a number of other risk factors. These include being over 30 years old, high parity, previous venous thromboembolism, obesity, prolonged bedrest and Caesarian sections (Henry, 1975). The use of ethinyl stradiol to suppress lactation has also been reported to increase the risk of postpartum venous thromboembolism (Daniel, Campbell & Thurnbull, 1967).

Many factors have been suggested as causative of the increased risk of DVT during pregnancy and the peurperium. One is the slowing of the venous flow in the lower limbs by pressure from the gravid uterus. This is consistent with the studies of Wright et al. (1951) who reported changes in the rate of blood flow in the leg during pregnancy. The velocity of venous flow was measured by radioactive sodium before and after pregnancy. They found that foot-groin flow rate, measured after injection of radioactive sodium into a foot vein, increased progressively during the course of normal pregnancy, decreased in the late stages of pregnancy and during labor. In one patient who developed clinical thrombosis during the peurperium, a higher rate of venous flow speed continued after delivery in the unaffected limb. Another factor in the development of DVT is referred to as the coagulation changes during normal pregnancy, delivery and the puerperium. During pregnancy, it has been documented (Bonnar, McNicol & Douglas, 1970) that there is an increase in the level of plasma fibrinogen and factors VII, VIII, and IX. During delivery, at the time of placental separation, there is a release of tissue exhibiting thromboplastin-like activity into the circulation (Bonnar et al., 1970).

The peurperium has been identified as the period of greatest risk as two-thirds of all pulmonary embolic

deaths occur at this time (Morris & Mitchell, 1977). The rise in platelet count (observed by Wright, 1942) might account for this. Reports of the use of estrogen-oral contraceptives has been suggested to be associated largely with an increased risk of venous thromboembolism. According to Gallus (1976), these reports have been surrounded by controversy due to improper selection of cases and controls, small sample size, and the fact that the diagnosis of DVT was not confirmed by a more objective method such as venography. He also assumed that the disorder was misdiagnosed since the first report made physicians sensitive to a possible relationship between oral contraceptive use and the occurrence of DVT.

Two studies used reliable methods to diagnose DVT. The first was reported by Imman and Vessey (1968) who made the diagnosis of fatal pulmonary thrombosis in 88% of patients at the autopsy examination. In spite of this high incidence, the possibility of improper selection persists.

The second study was reported by Teinstein (1975) who used 125I fibrinogen scan to diagnose DVT in 50 young women after abdominal surgery. Thirty had taken oral estrogen contraceptives until the time of surgery and six developed DVT, while none of the 19 similar patients who did not use contraceptives developed the disorder (Teinstein, 1975). The small size of the

sample and the possibility of inadequate matching of treated patients with controls rendered the results biased.

There is evidence that the incidence of thromboembolism is lower with oral contraceptives that contain 50 µg of estrogen as compared with those containing higher doses. However, it is not known if any dose of an oral contraceptive containing estrogen can be considered without risk (Stoley, Tonascia, Tockman, Sartwell, Rutledge & Jacobs, 1975). The mechanisms through which estrogen-containing oral contraceptives may be predisposing factors to venous thrombosis is not clear. However, their use has been reported to induce changes in platelets and in clotting factors that are similar to those changes occurring during pregnancy (Poller, Tabious & Thomas, 1968).

Obesity

Obesity has been reported as the first risk factor described for venous thromboembolism. In 1927, Snell found more cases of fatal pulmonary embolism after surgery in obese patients than in nonobese patients. Also, the incidence of embolism rose with increasing adiposity. More recent leg scanning studies by Kakkar et al. (1972) supported this finding. In a sample of 203 patients exhibiting several risk factors, 48%

of those with DVT were overweight.

Research of oral contraceptives and thromboembolic disease also provided supporting data. Women of child bearing age experiencing thromboembolism of unknown origin were generally heavier that those without thromboembolism, the average weight difference being about seven pounds. Since there is a tendency for women who use oral contraceptives to gain weight, this might contribute to the increased risk of thromboembolism (Vessey & Doll, 1968 and World Health Organization, 1966, Technical Report Series, No. 326).

The mechanism by which obesity increases the risk of venous thromboembolism is not clear. The overweight person tends to be less physically active, and their free movements are usually restricted, especially in middle-aged and elderly patients confined to bed. The risk of venous stasis in the lower extremities is thereby increased. Impaired fibrinolytic activity has also been reported in obese subjects (Almer & Janzon, 1975).

Ethnic Factors

The incidence of postoperative thrombosis detected with 125I fibrinogen leg scanning has differed in various parts of the world. Reports from Sudan, Thailand, and Malaysia have shown a variance of 2 to 12 percent

in the incidence of DVT detected with 125I fibrinogen after abdominal surgery (Hassan & Rahman, 1973).

When these results were compared with the 25% to 40% incidence of DVT found by British investigators after a similar type of surgery, a suspicion arose that ethnic factors might play a role in the risk of post-operative thrombosis. However, a 5 to 18 percent incidence of DVT after abdominal surgery has also been found in investigators from Britain (Sripad, Antcliffe, & Martin, 1972), Canada (Gallus, Hirsh & Tuttle, 1973), and the United States (Albernethy & Hartsuck, 1974). Regarding these wide differences in the percentages of the incidence of DVT in reports from various parts of the world, Gallus (1976) suggested that in order to get a reliable answer to this question, a direct comparison of the risk of thrombosis should be made in patients from different ethnic groups, after similar types of surgery in the same institution using the same diagnostic methods. Otherwise, there is no way to determine the actual role of ethnicity as a risk factor in the development of DVT.

Past History of Venous Thromboembolism

A previous history of venous thromboembolism has been widely recognized as a potential risk factor for further thrombosis after surgery or during immobiliza-

tion. Kakkar et al. (1970) reported a two to three-fold increase in the incidence of venous embolism after abdominal surgery, among patients with a past history of DVT, using 125I fibrinogen leg scanning. Among gynecological patients it has also been shown that the frequency of venous thromboembolism is about three times greater than in those without a past history of DVT (Thurnbill, 1960).

Blood Group

Jick, Slone and Westerholm (1969) researched the blood groups of white women developing thromboembolism while taking oral contraceptives, during pregnancy or the peurperium or at other times. Patients with blood group 0 were reported to have one-half to one-third the incidence of clinically diagnosed venous thrombo-embolism. Blood group 0 patients with duodenal ulcer were also reported to more liable to bleed than others (Langman & Doll, 1965). However, when 125I fibrino-gen was used on blood group 0 patients to diagnose DVT after surgery, contrary to expectations, a decrease in the risk of leg DVT was not found. Currently, the rela-tionship between leg DVT and blood groups remains un-clear.

Other Factors

Several other positive associations with DVT have been suggested, but they lack statistical support.

Seasonal variations. Autumn and Spring have been reported as periods during which the incidence of DVT is high (Newton, 1951). Seasonal incidence sometimes varies from year to year which suggests that it is just a matter of coincidence. Meteorological conditions have also been suggested as influences in the occurrence of thromboembolic phenomena (DeTakats, Mayne & Peterson, 1940).

Theoretically, low barometric pressure might enhance venous dilatation, thereby decreasing the speed of venous flow, thus favoring the occurrence of stasis and its thromboembolic consequences.

Because of the significance of anemia in clot retraction, it was mentioned by Quick (1950) Hirchboek and Coffey (1974) that a possible relationship exists between anemia and thrombogenesis.

Polycythemia. Trusseau (1968) mentioned the occurrence of thrombophlebitis migrane in some patients with this condition. However, no further investigation has been reported relative to this association (Hume et al., 1970).

DVT has also been implicated as a consequence of

diabetes mellitus, gout, smoking and the administration of adrenocorticotropic hormone (ACTH). However, these relationships cannot yet be definitely established as predisposing conditions due to lack of supporting research (Hume et al., 1970).

In certain groups of patients, the simultaneous presence of various risk factors produces a high probability of venous thrombosis and pulmonary embolism. An example of this would be an elderly patient with hip-fracture, confined to bed because of postoperative complications such as pneumonia or heart failure.

Research Questions

The research questions investigated in this project were:

1. What effect does duration of bedrest have on the occurrence of deep-vein thrombosis in patients who have undergone total hip replacement surgery at a Salt Lake City hospital?
2. What significance do the variables of age, sex, obesity, presence of heart disease, varicose veins, malignancy, blood type, type of anesthesia, past history of thromboembolisms and smoking have on the occurrence of deep-vein thrombosis in post-

hip replacement surgical patients?

Definitions

Bedrest

The term bedrest refers to the period the patient lies in bed during hospitalization. Its duration was established by hospital records indicating the number of postoperative days before starting ambulation with partial or total weight bearing. The day following total hip replacement surgery was considered postoperative day one.

Deep Vein Thrombosis

Deep vein thrombosis was defined as the formation or development of a blood clot in a vein of the extremity. Its evidence was determined by documentation on the hospital charts of diagnosis of leg deep vein thrombosis, pulmonary embolus, and thrombophlebitis. Diagnostic techniques such as 125I fibrinogen, Doppler ultrasound flow meter, impedance plethysmography, venogram, perfusion lung scan and clinical manifestation of thrombophlebitis documented as swelling of the lower extremities, local tenderness, and positive Homan's sign was considered documented diagnoses of leg DVT.

Pulmonary Embolus

The term pulmonary embolus refers to a thrombus that was detached from the deep veins of the legs and was carried along by the bloodstream to the lungs. Its evidence was determined by hospital records indicating results of perfusion lung scan or autopsy.

Total Hip Replacement

Total hip replacement or total hip arthroplasty was defined as the surgical procedure utilized to treat arthritis of the hip. In this procedure, the head of the femur and the acetabulum are replaced with metal components. Presently, the most common type of prosthesis used in total hip replacements are: Charnley, Charnley-Miller and Brunswick. Total hip replacement surgery was documented in the hospital records by descriptions clearly indicating the type and duration of procedure, day, type and duration of anesthesia and complications.

Assumptions

For the purposes of this investigation, it was assumed that leg deep vein thrombosis can be a complication due to prolonged bedrest.

It was also assumed that all pulmonary emboli were a consequence of leg deep vein thrombosis.

CHAPTER III

METHODOLOGY

This study was an ex post facto descriptive chart review of the medical records for data on the incidence of deep vein thrombosis during bedrest in patients who underwent total hip replacement surgery. The study was approved by the hospital's Chief of Medical Records at the data collection site.

Method of Data Collection

The data were obtained by reviewing the charts of 100 patients who had undergone total hip replacement (THR) surgery at a Salt Lake City hospital. The medical records reviewed dated from January 1982 through September 1982. Information was collected in narrative form from the subject's health history, physical therapy report, laboratory report and nursing notes. The Appendix contains a sample of the data collection form used. The standard of measure was the frequency at which a variable was recorded on the medical records. The risk factors for DVT and complications which were selected for analysis were those having been most commonly cited

in the literature as having been associated with the development of DVT.

Limitations

The nurse investigator identified the following limitations:

1. The unreliability and nonspecificity of clinical signs in the diagnosis of deep vein thrombosis;
2. The role of anticoagulant therapy in the prevention of deep vein thrombosis;
3. The possibility of incorrect and/or incomplete information having been documented in the medical records; and
4. The lack of control over the validity of negative diagnosis of deep vein thrombosis.

CHAPTER IV

RESULTS AND FINDINGS

The frequency of occurrence of the variables were calculated as percentages. Further analysis was not possible because there were no instances of deep vein thrombosis in the sample documented. One hundred and four total hip replacement surgeries were performed on 100 patients between September 1982 and January 1983. Sixty-one patients were female and 39 were male. Ninety-three percent of the patients were greater than 60 years of age, with a range of 30 to 99 years. Thirty-nine percent were between 70 and 79 years old, while 28 percent fell in the 60 to 69 years old range. Fifty-three percent of the surgeries affected the right hip while 43 percent affected the left. There were four instances of bilateral THR surgeries. Table 1 summarizes the demographic characteristics of the sample.

Research Questions

Research Question One

Research question one stated:

What effect does duration of bedrest have on

Table 1

Demographic Characteristics of the Sample

Variable	Number of Patients
Total Sample Number	100
Number of Surgeries	104
Procedures:	
Right hip	53
Left hip	43
Bilateral (done 1 week apart)	4
Sex:	
Female	61
Male	39
Age:	
Mean	68.80
Range	30-99 yrs.

the occurrence of deep vein thrombosis in patients who have undergone total hip replacement surgery at a Salt Lake City hospital?

The majority of the patients (70%) experienced three days of bedrest and 16 percent had two days. The longest duration of bedrest was nine days. Four percent of the patients experienced four days of bedrest; five percent, five days and one percent, eight days. These differences in duration of bedrest were due to occurrence of postsurgical complications other than DVT. One patient experienced only one day of bedrest while one walked in the corridor on the first postoperative day due to disorientation (Table 2).

According the criteria established, there were no documented occurrences of DVT in the 100 medical records investigated. However, five patients presented characteristics and complications which led the investigator to categorize them as possible undiagnosed DVT.

Research Question Two

Research question two stated:

What significance do the variables of age, sex, obesity, presence of heart disease, varicose veins, malignancy, blood type, type of anesthesia, past history of thromboembolism and smoking have on the occurrence

Table 2

Duration of Bedrest Among Subjects

Number of Subjects	Days of Bedrest
1	9
1	8
1	6
5	5
4	4
70	3
16	2
1	1
1	0

of deep vein thrombosis in post-hip replacement surgical patients?

Eight percent of the patients had no documented risk factors for development of DVT. All were under 60 years of age and were relatively healthy. This was an unexpected finding since patients who undergo the procedure are usually older. The second most prevalent risk factor was obesity (30%). Obesity was not clearly presented in the medical records. The risk factor was, therefore, calculated from the heights and weights of the patients. Obesity was considered present when the patient's weight was equal to or greater than 15% in excess of the desirable weight for a large-framed person of the patient's height (Craddok, 1978).

The third most prevalent risk factor was heart disease (16%). It was represented by the presence of congestive heart failure, or previously treated myocardial infarction, or occurrence of myocardial infarction during the hospitalization. Varicose veins were present in seven percent of the sample, malignancy in one percent, diabetes in seven percent, gout in two percent and nine percent were smokers. The presence of four simultaneous risk factors for DVT was documented for two percent of the patients, three simultaneous factors presented in nine percent, two were evidenced in 36% of the sample while

45% of the patients had at least one of the identified risk factors (Table 3).

One hundred percent of the patients wore Ted® hose and had general anesthesia with controlled ventilation and muscle relaxant therapy. For 98 percent of the patients, anticoagulation was documented following different protocols. From January to April of 1982, the most prevalent protocol was 10 mg of Warfarin Sodium (Coumadin) by mouth the night prior to surgery. Eighteen percent of the patients received this prescription. Between May and September 1982, the prevalent protocol changed to 10 mg intermuscular Coumadin given in the recovery room. Anticoagulants were also given in different dosages and times, for example, nine percent of the patients received anticoagulant medication on the day of surgery (10 mg orally); two percent the night after surgery (10 mg orally); seven percent started anticoagulation postoperatively; one percent at six days, two percent at one day; one percent at three days and one percent at two days (dosages respectively were 7.5, 10, 5 and 5 mg of Coumadin orally). The reason for the variability in days and dosages was not clear to the investigator.

Two percent of the subjects received no anticoagulant therapy, which was because of the patient's condition pre- and postoperatively such as hematuria and development of intraabdominal hematoma postoperatively,

Table 3

Types of Prevalence of Risk Factors for DVT

Risk Factor	Number of Patients
Age > 60 years	93
Obesity	30
Heart disease	16
Presence of varicose veins	7
Malignancy	1
Gout	2
Smoking	9
Diabetes	7
Risk Factors per Subject	
0	8
1	45
2	36
3	9
4	2
5	0

and preoperative complications such as diabetes, status postcerebral vascular disease, and history of frequent transitory ischemic attacks. Table 4 summarizes the anticoagulation therapy utilized within the sample.

Various complications other than DVT were noted. Disorientation was noted in 17 percent of the patients, a decrease in hematocrit with no visible bleeding in eight percent, and visible bleeding was evident in five percent of the subjects. Clinical signs of DVT such as pain in the calf appeared in two percent while a positive Homan's sign was noted in only one percent of the patients. Table 5 presents a summary of the complications noted in this investigation.

Table 4

Summary of Anticoagulation Among the Subjects

Protocol[a]	Number of Subjects
No anticoagulation	2
NBS	18
RR	64
DS	9
NAS	2
DAS	7

Note. [a]NBS = night before surgery; RR = recovery room; DS = day of surgery; NAS = night after surgery; DAS = days after surgery (6, 1, 3 days).

Table 5

Summary of Complications Other than DVT Among the Subjects

Complication	Number of Subjects
Decreased hematocrit, no visible bleeding	8
Disorientation, confusion	17
Chest pain	4
Shortness of breath	3
Increase in temperature	5
Increase in blood pressure	1
Silent myocardial infarction	1
Pain in the calf	2
Homan's Sign (+)	1
Decreased blood pressure	2
Nausea and vomiting	5
Diarrhea	2
Urinary retention	6
Tachycardia	3
Atrial fibrillation	2
Constipation	2
Dysuria	2
Urinary tract infection	2
Mild anemia	1

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

Discussion

As discussed in the review of the literature, the incidence of thromboembolism is proportional to the duration of bedrest. There is extensive evidence to support that elderly patients with trauma or reconstructive surgery about the hip have a high risk of thromboembolic complications. The figures vary from 37 to 69 percent depending upon the technique used for diagnosing the thrombosis and the nature of prophylactic measures.

The results of this investigation indicated that ambulation following three days of bedrest after THR surgery is apparently sufficient to avoid venous embolic complications. There was no documentation of deep vein thrombosis in the 100 medical records reviewed.

However, important factors limited the validity of the results obtained. First, the investigation was an ex post facto descriptive study and the diagnoses of DVT were merely based upon clinical signs. As discussed in an earlier chapter, several limitations influenced the results. Briefly, the following are the most related

to the statement above:

1. The possibility of incorrect and/or incomplete information being present in the medical records.

2. The unreliability and nonspecificity of the clinical signs associated with the diagnosis of DVT.

3. The lack of control of validity of the negative diagnoses of DVT.

4. The difficulty in verifying the accuracy of DVT diagnoses made by differing observers.

As is pointed out in the literature, more than 50 percent of patients in whom DVT is clinically suspected do not have confirmation by objective test (Gallen, Hirsch, Hill & Van Aken, 1976). The differential diagnosis includes: muscle strain, vasomotor changes in a paralyzed leg, direct twisting injury to the leg, lymphangitis, muscle tear, hematoma, heart failure and the postphlebotic syndrome (Hull & Hirsh, 1981). Second, the preventive measures used at a Salt Lake City hospital for thromboembolic complications are intensive physiotherapy, early ambulation and anticoagulant therapy.

The present findings are similar to those of Coventry et al. (1973). They cited a four percent incidence of DVT in patients not treated with prophylactic anticoagulants. They used intensive physiotherapy and early

ambulation (no more than three days of bedrest) as primary prophylaxis. Patients who were not able to follow the postoperative ambulation program were given anticoagulant medication. None of them developed DVT. The present study indicates, within the limits of the method used, that a combination of early physiotherapy and the use of anticoagulants is adequate to prevent occurrence of clinically demonstrable DVT.

Another factor that may have protected the subjects from DVT was a high incidence of type "O" blood. Forty-five percent of the patients in this study had type O blood; appreciably almost the same incidence was found in Sweden (Jick et al., 1969). The authors identified different distinctive genetic patterns that show differences in the tendency to develop venous thrombosis.

The incidence of pulmonary embolism varies widely, again due to inaccuracy and nonspecificity of the current tests employed for diagnostic purposes. "The value and limitations of most tests that are in use for the diagnosis of pulmonary embolism have never been adequately assessed" (Hill & Hirsch, 1981, p. 190). Therefore, the most accurate statistics are the results of autopsy studies. It is estimated that 100,000 hospitalized patients in the United States die yearly from pulmonary embolism and the frequency of fatal pulmonary embolism in treated patients undergoing hip surgery is 0.3 to 1.7 percent

(Harris, Salzman & DeSanctis, 1967). This investigator concluded that the sample size of the present study was not adequate to detect incidence of fatal pulmonary emboli.

The risk factors for DVT documented in the 100 charts of patients who had undergone the surgery reviewed do not differ from those mentioned in the literature. However, there was no evidence of special prevention methods against DVT according to number and nature of risk factors. All patients received the same prophylactic treatment no matter what type or number of risk factors were present.

The most prevalent complication other than DVT was confusion which this investigator assumes to be due to postoperative hypoxia secondary to anesthesia. Wound infection associated with bleeding was documented only in one patient. Thirteen percent of the patients had bleeding problems. Although detection of complications other than DVT was not the main purpose of this study, 13 percent is a significant number considering the expenses involved in prolongation of hospital stay, transfusions and laboratory monitoring.

Of the four patients experiencing chest pain, two had lung scan tests which were both negative for pulmonary emboli. No further investigation for DVT such as venogram was documented. Since there is a possibility

of spontaneous resolution of thrombi at the time a perfusion lung scan test is performed, a more intensive investigation for DVT of the legs should be pursued.

Isolated signs of DVT such as pain in the calf were documented in only two percent of patients and positive Homan's signs in only one. Although the incidence of these signs is not significant, it should be pointed out that patients with relatively minor signs and symptoms have extensive venous thrombosis, while patients with symptoms and signs suggesting extensive DVT have no objective evidence of venous thrombosis (Hull & Hirsch, 1981).

The majority of the complications cited in the present study were documented in the nurses notes. It is evident the nurse's preoccupation with prevention and detection of a possibility of DVT was present. However, it was not possible to detect in the medical records an awareness of patients more prone to develop the disorder.

Five subjects experienced risk factors and complications which led the investigator to categorize them as possible undiagnosed DVT. As previously noted, there were no documented cases of DVT in the 100 charts reviewed. The prophylactic methods used and the nature of the complications experienced suggests that perhaps they did not develop DVT and if they did it may not have

been a significant episode. These five patients, however, had at least two or more simultaneous risk factors for DVT. Some of these such as obesity, past history of pulmonary emboli and congestive heart failure are strongly correlated with the development of venous thromboembolism. Although the complications experienced by these patients were more like isolated signs of DVT and/or pulmonary embolus, in this investigator's opinion, a more objective test to definitely rule out DVT was needed. Table 6 summarizes the data pertinent to these five cases of possible undiagnosed DVT patients.

Summary and Recommendations

This study focused on the relationship between duration of bedrest and incidence of DVT in patients who had undergone total hip replacement surgery at a Salt Lake City hospital. There were no cases of DVT documented in the 100 charts reviewed.

As previously discussed, several limitations in this research influenced the results. The fact that the study was conducted retrospectivelv and the use of clinical signs to detect DVT were particularly strong limitations to the validity of the negative findings.

However, it was also the investigator's intention to analyze the magnitude of the DVT problem at a hospital in Salt Lake City. The rationale for this included:

Table 6

Risk Factors, Bedrest Duration, Anticoagulation and Complications Among Patients with Possible Undiagnosed DVT

Patient Number	Sex	Risk Factor	Bedrest	Anticoagulation	Complications
25	F	64 years old, obese	3 days	10 mg P.O. NAS	Pain in the calf, Homan's sign (+), increase in temperature
27	M	60 years old, past history of PE, obese	3 days	10 mg P.O. NBS	Chest pain, lung scan (-) leg pain
71	M	70 years old, diabetes, status post CVA, TIAS, chest pain, congestive heart failure, hypertension	9 days	No	Hematuria, agitation, shortness of breath
89	F	70 years old, pulmonary fibrosis, status post cardiac valve replacement, congestive heart failure	3 days	No	Intraabdominal hematoma, shortness of breath, bilateral ankle edema

Table 6 Continued

Patient Number	Sex	Risk Factor	Bedrest	Anticoagulation	Complications
100	F	77 years old, smoking, emphysema, obese, coronary heart disease, pulmonary hypertension	5 days	10 mg IMRR	Chest pain, hemoptysis, atelectasis, patient was transferred to CCU because of chest pain which was attributed to pleuritic disorder and responded to Indocin treatment.

Note. PE = pulmonary embolus; TIAS = transient ischemic attacks; CVA = cerebral vascular accident; P.O. = by mouth; NAS = night after surgery; NBS = night before surgery; IMRR = intramuscular at recovery room.

a) the fact that a massive or fatal pulmonary embolus is a relatively rare event in the life of an individual nurse or orthopedic surgeon. For instance, one death from pulmonary embolus can happen every one to two years in an orthopedic unit; b) side effects attributed to the prophylaxis approach usually are highly visible whereas benefits from prophylaxis can pass unnoticed; c) patients' activity is highly linked to nursing care. The ideal primary prophylaxis method for DVT should be safe, effective, well accepted by nursing and medical staff. In addition, it should be inexpensive and require minimal monitoring. At present, none of the currently available preventive methods for DVT fulfill all the criteria for an ideal prophylatic agent.

Early ambulation can be applied as a routine, but using it alone does not appear to be effective. The combination of early ambulation with intensive physiotherapy plus oral anticoagulants for these surgery patients appears to be effective as demonstrated by the present study. However, further prospective research using a more sophisticated technique to detect DVT is necessary to confirm the efficacy of this approach. Moreover, since complications of oral anticoagulants such as bleeding problems and the expenses of laboratory monitoring are a fact for those who use this type of preventive method, oral anticoagulants should be used

only in high risk patients.

Another preventive method for DVT in patients undergoing hip surgery which warrants further study is the use of graduated pressure stockings and inflatable pulsatile stockings. If the results prove to be effective, this approach could be used particularly with patients for whom anticoagulants cannot be prescribed.

Implications for Nursing

The fact that clinical signs are not a reliable way to detect DVT and thus prevent pulmonary embolism does not exclude nurses from participating in preventing or monitoring the occurrence of the disorder. An awareness of the risk factors for DVT and an organized strategy of prevention must be developed among the nurses involved with hip surgery patients. Nurses should participate in the selection of the high risk patients for the use of the most suitable prophylaxis. A screening with the technique available should be performed prior to surgery in high risk patients for whom anticoagulant therapy is not applicable.

The clinical signs for DVT and pulmonary embolism are not reliable but they are the ones that summon the attention of the health team for a more objective test. Only by maintaining a high index of suspicion and an

acute awareness of these complications, may they be detected and promptly treated.

APPENDIX

SAMPLE DATA COLLECTION FORM

Data Collection Form

Code Number_____

Weight_____Height_____ Admission Date_____

Age_____ Sex_____ Blood type_____

Occupation_____

Presence of the Following Risk Factors:	Yes	No
Over 60 years of age	___	___
Heart disease	___	___
Presence of varicose veins	___	___
Past history of venous embolism	___	___
Malignancy	___	___
Diabetes	___	___
Smoking	___	___
Obesity	___	___

Past and current medication_____

_____

Blood work on admission_____

_____

Surgery:

Type of anesthesia_____

Controlled Ventilation_____
No Controlled Ventilation_____
Use of Muscle Relaxants_____

Operation time_____

Duration of bedrest in days_____

Angicoagulant therapy: Yes_____ No_____

Type_____dosage_____

Deep vein thrombosis: Yes____ No____

Use of Ted Hose: Yes____ No____

Other Complications:

_____

_____

_____

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